

Improving Flash Flood Forecasts Through a Synthesis of NASA Products, NWP Models and Flash Flood Decision Support Systems

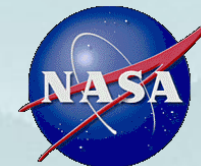
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²National Center for Atmospheric Research, Research Applications Program

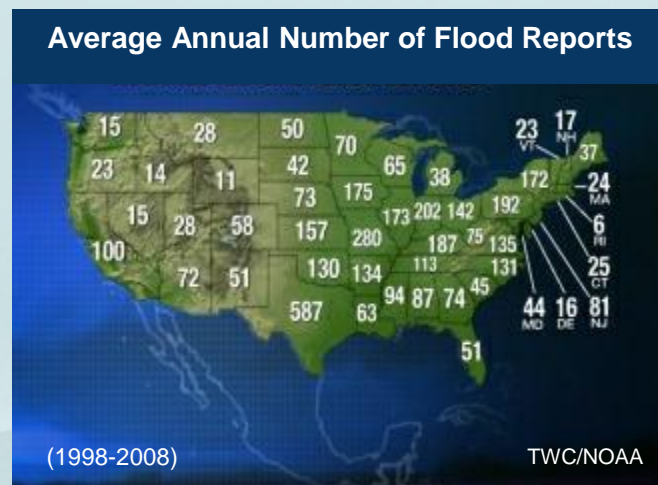
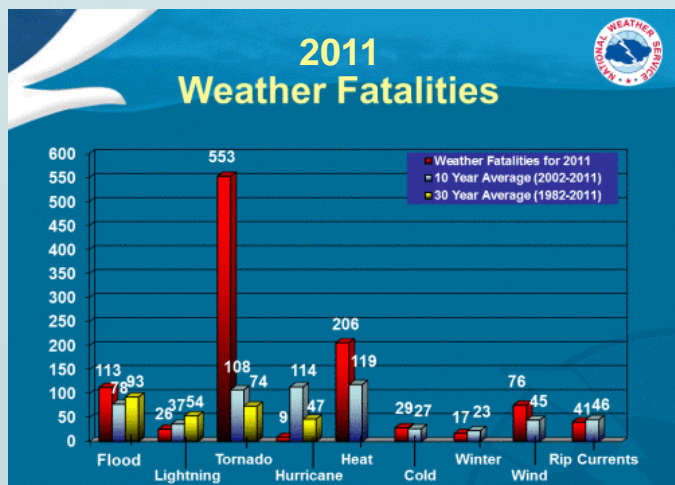
³NASA GSFC, Hydrologic Sciences Branch

Funded by NASA Water Management Program



Introduction

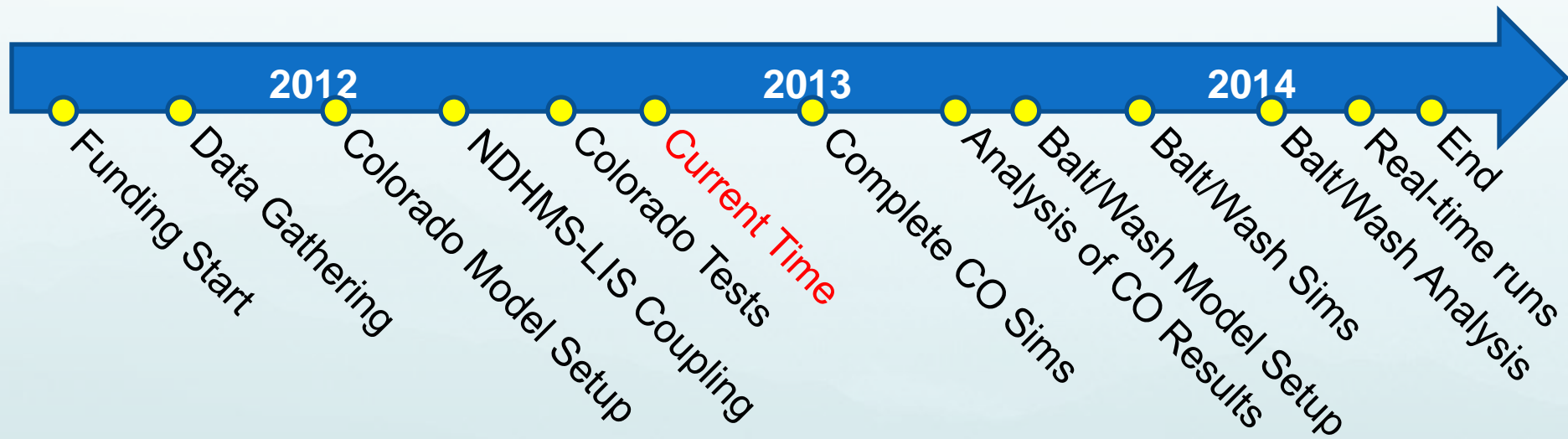
- Flash floods – one of the deadliest weather events
- Current decision support systems limited by:
 - Simulation skill
 - Availability of high resolution quantitative precipitation forecasts
- NWS-NCAR-GSFC Project will address this through:
 - Producing/testing high resolution forcing data
 - Gauging impact of shift toward higher model resolutions
 - Partnering with NWS WFOs and RFCs



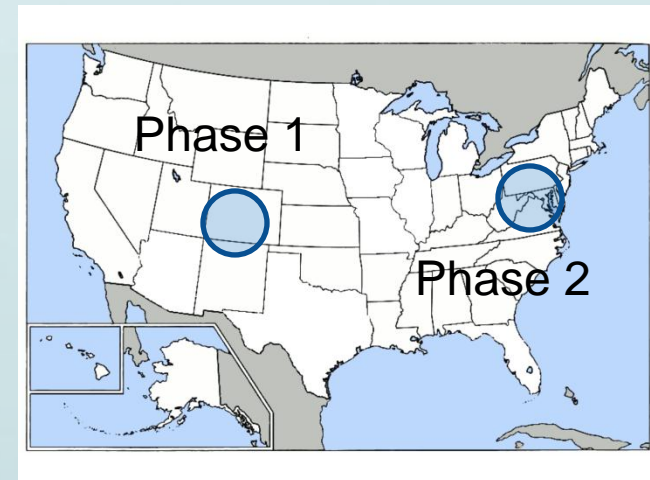
Toward Improving Flood Forecasting

- **Goal: Improve operational flood forecasting with model/forcing improvements**
- Multi-institution toolset used to generate stream flow forecasts
 - NWS/OHD Sacramento Heat Transfer Evapotranspiration (SAC-HTET) and Snow17 models
 - NCAR Distributed Hydrologic Modeling System (NDHMS)
 - NASA GSFC Land Information System (LIS)
- Multiple sources of quantitative precipitation data for forcing models
 - 4km NWS operational Multisensor Precipitation Estimates MPE
 - 1km NWS High Resolution Precipitation Nowcasts (HPN)
 - 1km NCAR Titan precipitation nowcasts
 - 1km WRF precipitation forecasts
 - 1km Colorado State CHILL Dual-Polarimetric Radar
- Anticipated Impacts
 - Increased flash flood forecast lead time
 - Improved spatial accuracy of flash flood forecasts
 - Reduction in over-warned area
 - Increased understanding of benefits of high resolution modeling

Project Schedule



- Project Phase 1 (retrospective)
 - Colorado domain, small-scale convective events
- Project Phase 2 (retrospective and real-time)
 - Baltimore/Washington WFO domain, tropical event
- Phase 1 and Phase 2 benchmarks
 - DSS runs using typical operational precipitation forecasts
 - USGS and local network stream flow and return period observations
 - NWS Storm Event Database flash flood records

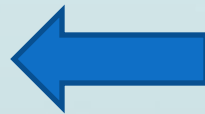


Recent Developments

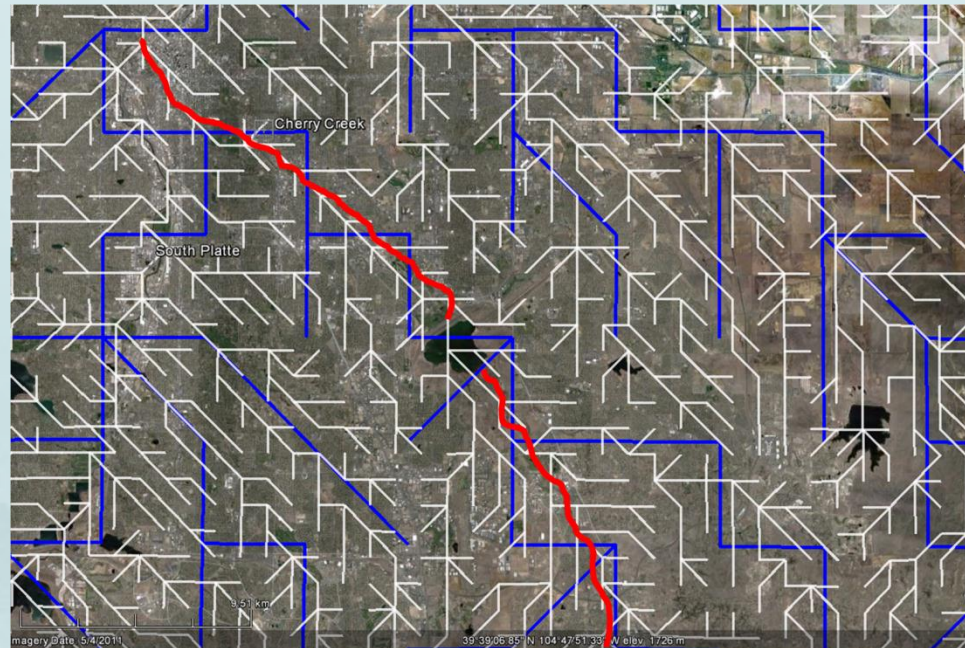
- NASA-LIS and NDHMS coupled into flood simulation system
- LIS-NDHMS & SAC-HTET configured for Front Range domain
- Initial uncalibrated 4km and 1km simulations conducted



How will more realistic representation of stream network and routing parameters impact flood and flow simulations?

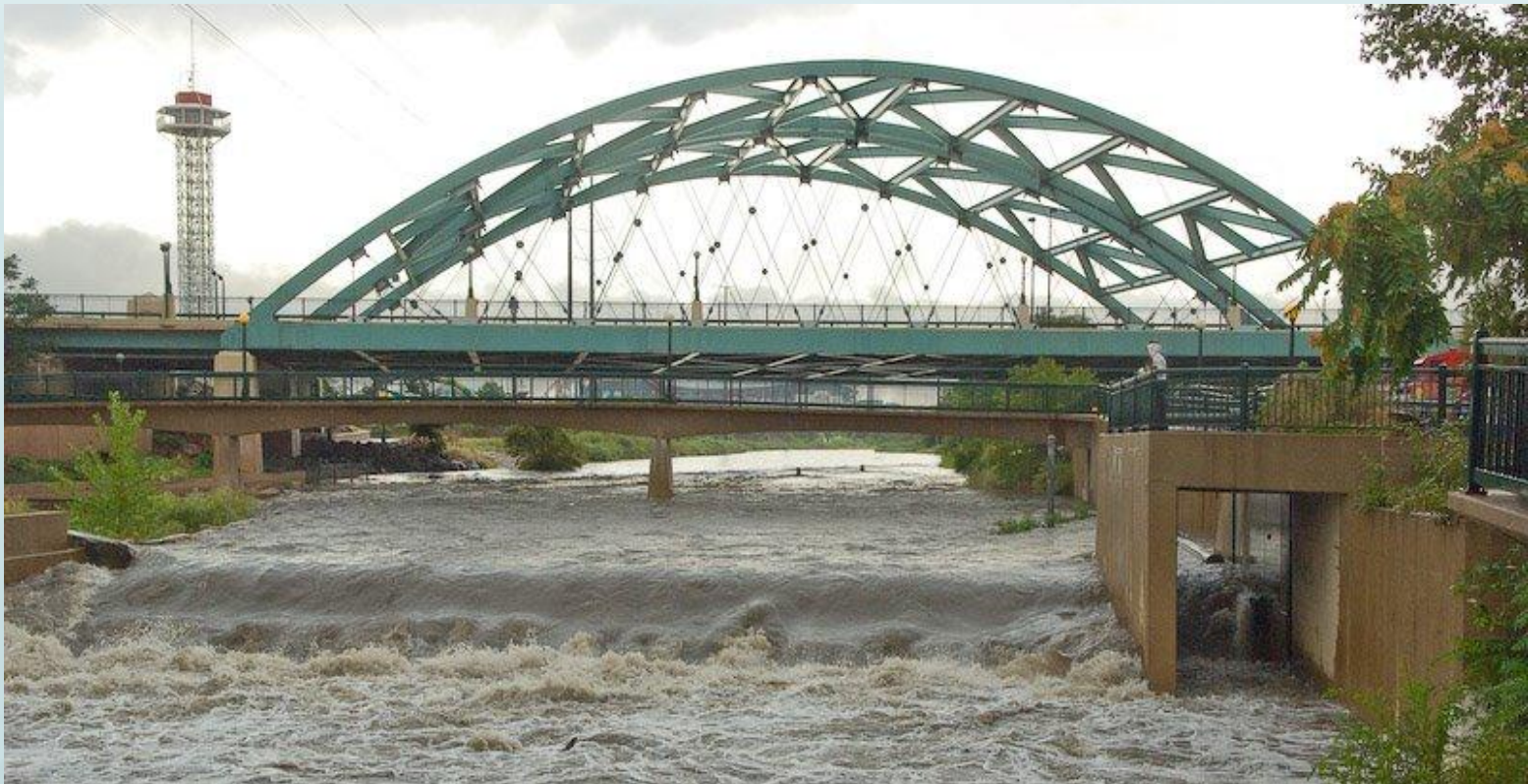


- 1km model stream network
- 4km model stream network
- Actual location of Cherry Creek



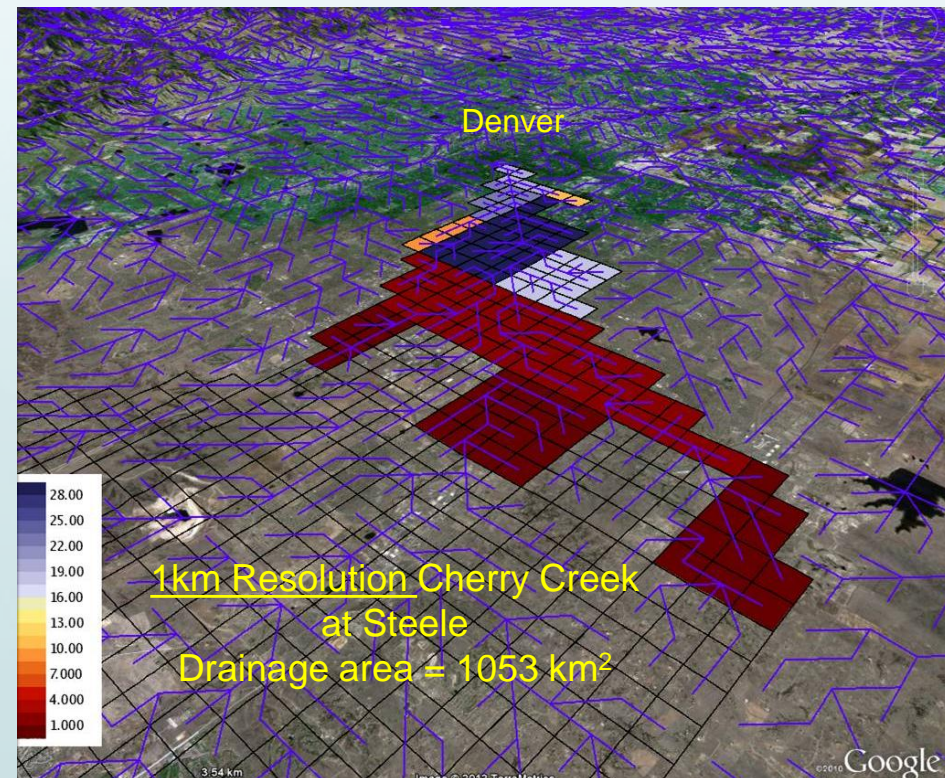
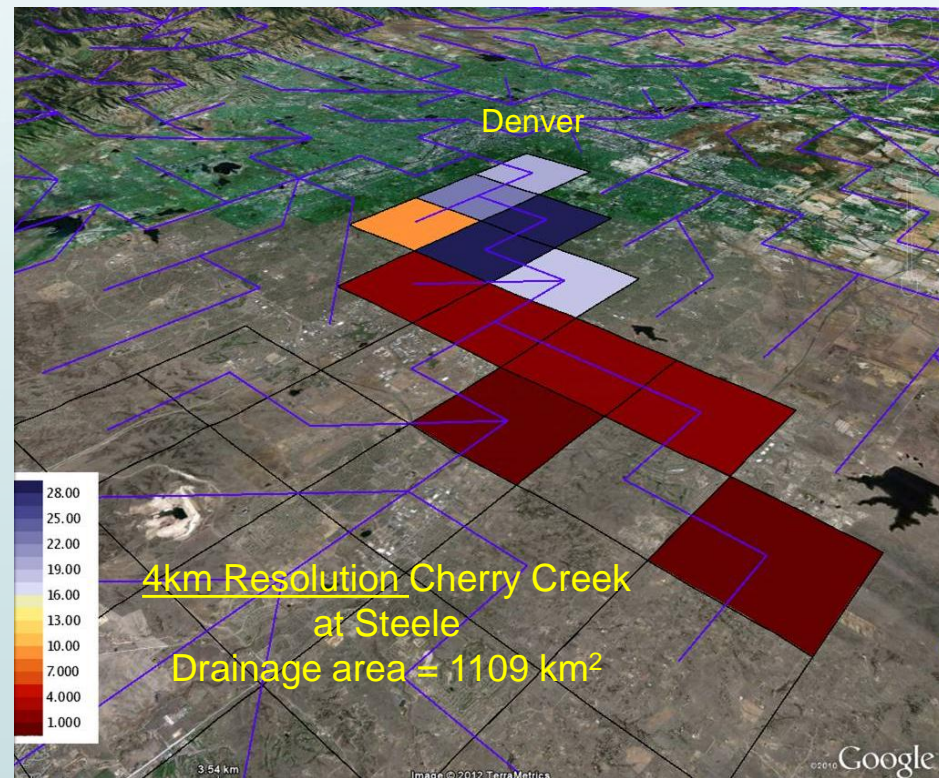
Test Case: Cherry Creek Flood August 8, 2008

- Localized heavy rain caused flooding along Cherry Creek in Denver
- Reproduced by uncalibrated SAC-HTET and NDHMS using QPE
- Titan & HPN QPF will be tested to see if lead time can be increased
- OHD DHM Threshold Frequency (DHM-TF) for return periods



Cherry Creek Precipitation Data

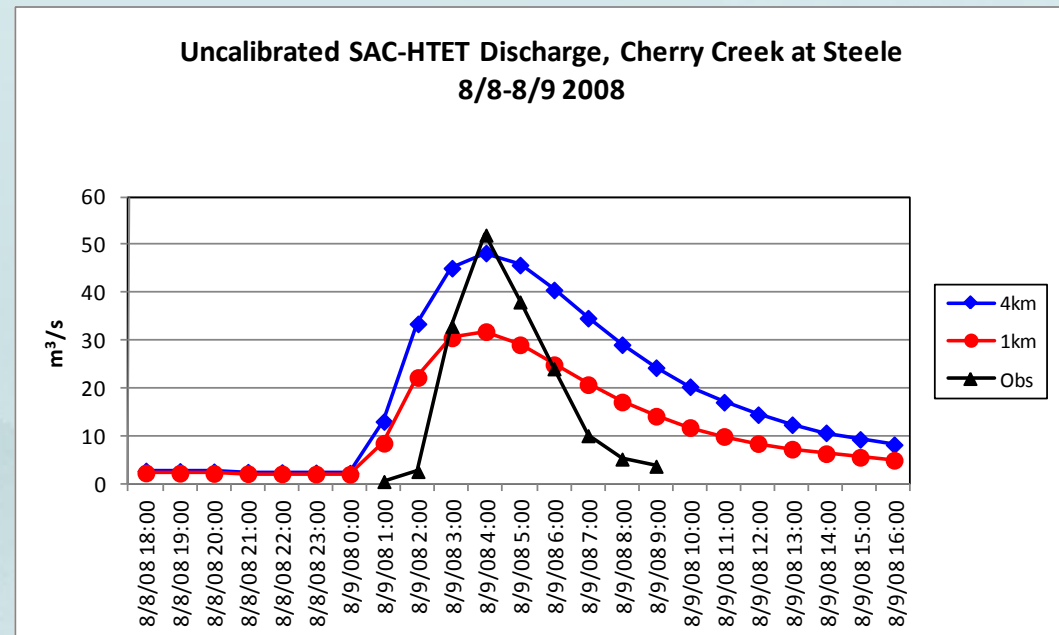
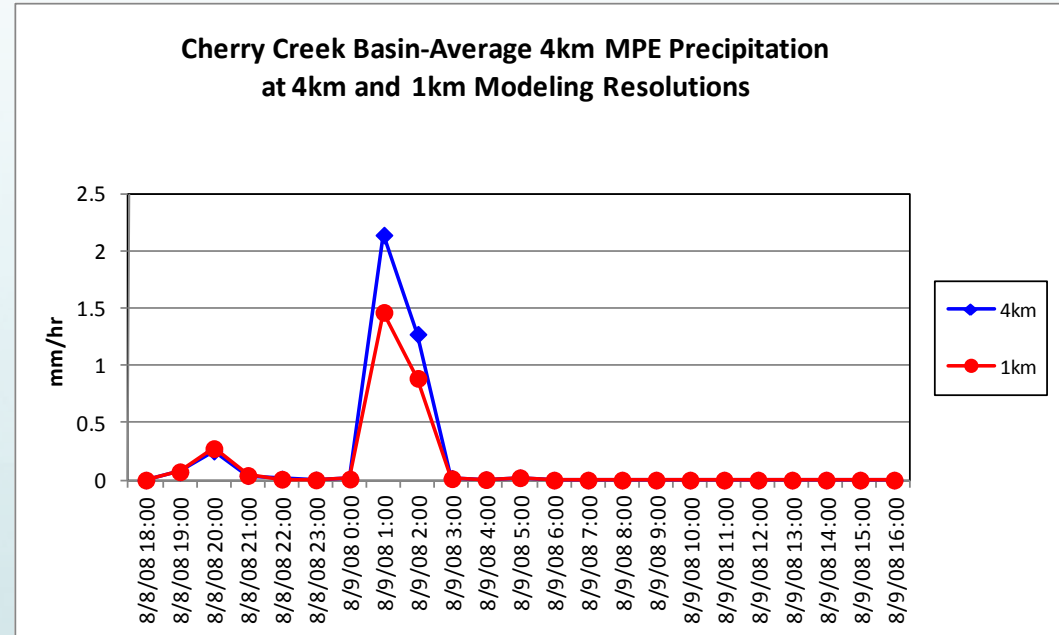
Hourly 4km NWS MPE Precipitation (mm) 02Z August 8th, 2011



- Operational NWS MPE QPE for 4km and 1km SAC-HTET
- Model representations of basin receive different precipitation

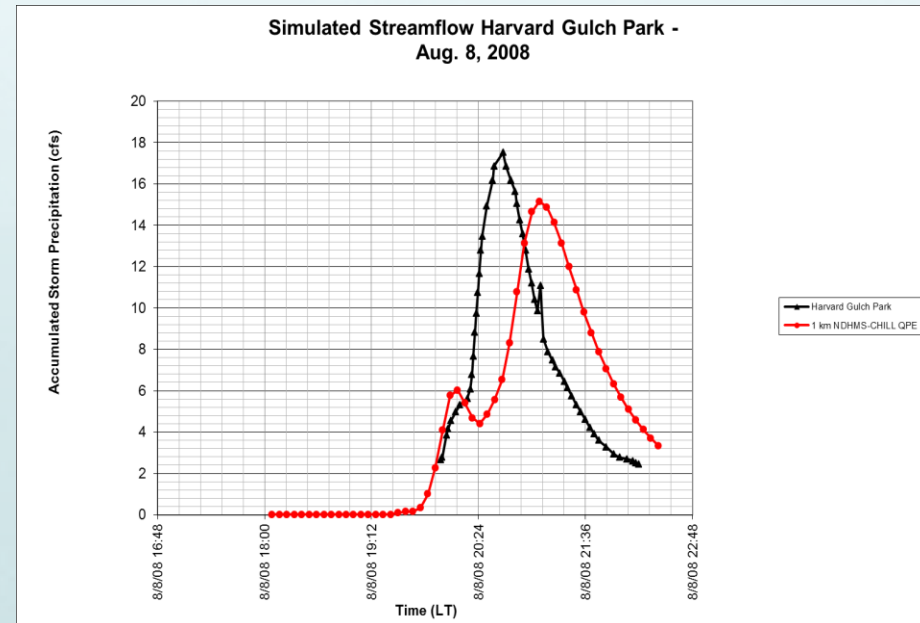
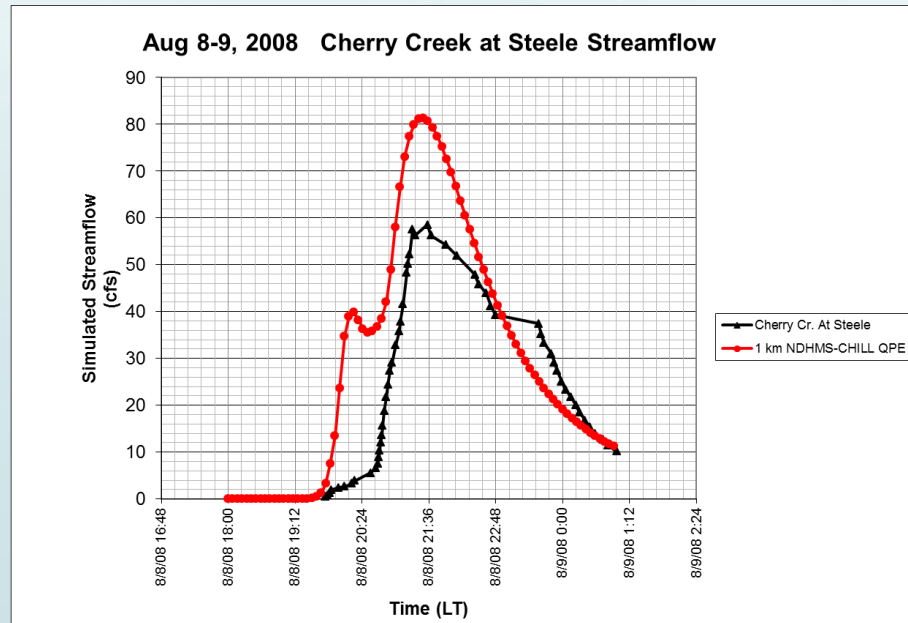
Cherry Creek Precipitation and SAC-HTET Discharge

- Coarse 4km resolution basin receives higher basin-averaged precipitation and yields larger peak discharge
- Uncalibrated 4km run performs better than 1km counterpart
- Counterintuitive, so will investigate relative impact of:
 - Modeling resolution
 - Forcing resolution
 - Calibration



Initial Results: NDHMS-Noah Simulations

- Evaluation of simulated stream flow using multiple precipitation products: August 8th, 2008



- Here the QPE is provided by the CSU-CHILL dual-polarimetric radar.
- Noah and CHILL QPE precipitation are on a 1km grid, NDHMS routing is executed on a 100m grid to resolve fine terrain features
- NDHMS-Noah is un-calibrated for these initial results
- LIS-NDHMS coupling near-complete

Future Work

- Complete coupling of LIS and NDHMS
- Calibrate LIS-NDHMS and SAC-HTET over study areas
- Conduct long-term runs for return period calculation
- Execute and validate 4km and 1km calibrated simulations
- Execute/validate over Baltimore/Washington WFO domain
- With WFO assess high resolution modeling system benefits

